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Automation on-line

Using the Internet for control and automation

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Control and automation communication systems have traditionally been proprietary and closed. The current trend is that technologies allowing industrial components to merge with computer networks are becoming less expensive. This fact, coupled with the explosion of the Internet and its technologies, is revealing new innovative solutions for control and monitoring systems. The power of the Internet in monitoring and troubleshooting cannot be overstated. Internet-compliant communications are going to be the basis for future automation solutions.

software, and utilities that function on the Internet can be used on an intranet.

The primary protocol for information exchange with the Internet or intranets is TCP/IP. TCP—Transmission Control Protocol—formats information to be transferred and adds header information and error checking to the stream of data. A lower level protocol called IP—Internet Protocol—routes the transferred information from one address to another. IP adds its own header and checksum to ensure the proper machine receives that information. TCP and IP work in conjunction, allowing computers to share resources across a network. The Internet and intranets are designed so that if links or sections fail, IP can

a moment, the utility of having a centralized computer on the plant floor that accesses the programs of every PLC in a process. Then, consider the even greater utility of being able to connect to these PLCs remotely using the Internet.

For example, several PLCs can monitor a process in an off-shore oil platform. The PLCs connect to a secure intranet network using Ethernet TCP/IP protocol. With this networking system, any computer inside the company's firewall may access each PLC by using the unique IP addresses of the PLC.

Such connectivity is the hallmark of easier system start-up. After mounting and terminating control panels, checking I/O, and configuring the PLC, the technician loads initial program in the PLC. Suppose a plant has several identical processes. After starting the program and then modifying it to correct errors, the technician must then load the program in the other panels. That is relatively easy. But, if the programs are similar, but not identical, the technician must now spend more time to modify the program several times and load the different copies in the appropriate PLCs.

Doesn't it stand to reason that if the technician had a central computer that could switch from one PLC to the next through its software, the programs could be loaded in less time and with greater efficiency? The truth is that it is possible to completely implement and start-up a PLC program over the Internet, saving a lot of re-work time.

There is benefit in monitoring a PLC program during the start-up and testing phase. Being able to select and monitor different PLC programs from the one location is useful. Centralized start-up monitoring gives the added convenience of allowing you to locate the computer in an office where schematics and other resources are easily accessible. Imagine being able to monitor a

Consider, for a moment, the utility of having a centralized computer on the plant floor that accesses the programs of every PLC in a process.

Background on Ethernet TCP/IP and the Internet.

The Internet is a conglomeration of networks throughout the world that forms a vehicle to exchange information between authorized participating machines. Intranets, on the other hand, are localized enterprise-wide networks of a smaller scope than the Internet. They use the same protocol suite, however. A company has full control over its own intranet and can assign network classes as needed. The use of company-wide intranets is growing rapidly. Intranets are a solid and uniform standard that simplifies a company networks because the setup and protocols are standard. In addition, tools,

route around them. Redundant routes lead to tremendous network reliability.

TCP/IP is a standard and essential element of wide area networking. Ethernet accepts messages from TCP/IP, adds a header and a checksum, and transmits a packet on the physical network.

The advantages of having a PLC on the Internet.

The centerpiece of contemporary automation is the programmable logic controller. Having the ability to remotely interface with a PLC holds many advantages. A key advantage is the ability to directly access the PLC program and configuration from a central or remote location. Consider, for

Instruments and Controls

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program from a desktop computer while seeking telephone support for a problem. It also means PLCs and office computers run simultaneously on the same hub.

Possibly the most beneficial advantage the Internet offers is the ability to connect an off-site expert with the PLC. Saving travel costs and time, the expert guides the technician through problem areas remotely and views the PLC program directly. Often, analyzing the PLC program reveals errors in the electrical control panel itself. This type of remote support saves time and money during both start-up and after a control system is in operation. If you cannot observe a control system from hundreds of miles away in the company's headquarters, you are at a competitive disadvantage.

Direct interface to PLC programs allows one to view or modify the programs. Multiple users may simultaneously view the same PLC. Human-machine interface packages or other applications operate normally while viewing or monitoring the program. Better grades of PLC allow 32 or more simultaneous connections.

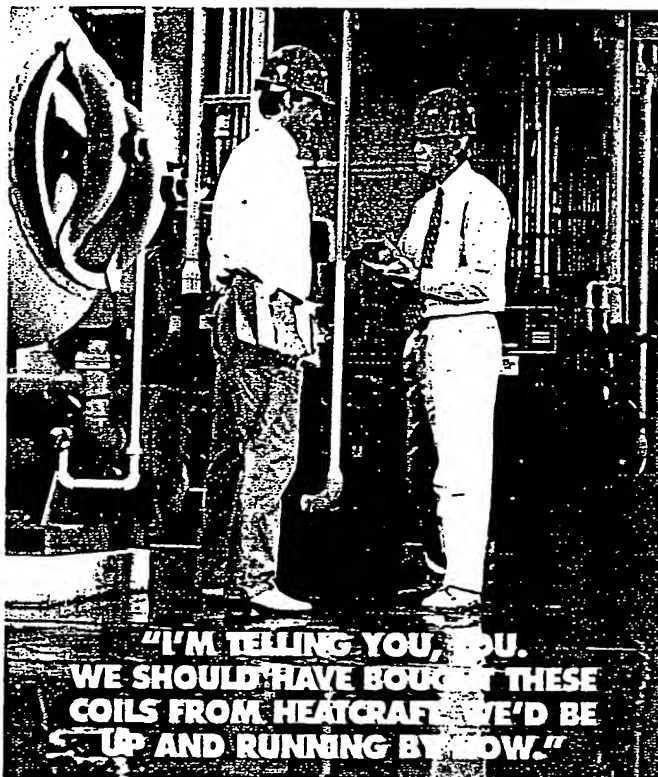
What does this multi-user feature suggest about improved training for instrument technicians? New technicians benefit from viewing the program remotely as it is implemented and modified. Allowing multiple outside experts to view and evaluate a program leads to quicker and more complete solutions. Use of the Internet or intranet in combination with a TCP/IP-compliant PLC communications module makes this connectivity possible.

Firewalls

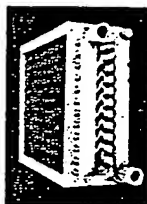
Network security is a concern at many companies, especially when control systems may be in jeopardy. To address this concern, state-of-the-art PLC programming software has built-in program and configuration security. In this scheme, several levels of security provide the ability to view the program, copy it, load a new program, change or manipulate the current program, and full access rights.

A user may refuse to grant PLC access to anyone lacking proper authority. In these in-

stances, custom hardware and software controls security. These "security gateways," known as firewalls, have varying levels of sophistication. They may act as a guard against unauthorized entry by verifying user name and password. The security gateway may grant access only to authorized remote machines with the proper IP address. A complex gateway may provide each of these fea-



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Contemporary human-machine interface software displays the information in any graphical or numeric format.

tures and then record detailed logs of traffic and attempted log-ins. It could e-mail or notify the administrator of certain conditions or allow only certain software programs to connect. If you feel your network is important, security is a crucial issue. You must take steps to protect the network with solutions that protect your system from both the local network and outside sources.

Human-machine interfaces

The better grades of PLC networks conform to TCP/IP standards and are easily accessible like any other computer on the network. You could establish a connection by entering the IP address only. This makes remote monitoring systems easy to implement. You could write custom applications or develop standard human-machine interface applications to monitor your PLCs. There are many human-machine interface software packages available today. Most of them are user-friendly and relatively easy to configure by an experienced developer.

These applications readily monitor any machine on the network. They monitor configured points in any established format. Suppose a user wishes to monitor the speed of six motors on a machine. Contemporary human-machine interface software displays the information in any graphical or numeric format. The application runs on any suitable computer locally or remotely without modification. This allows for central monitoring by several sectors—the plant floor, the corporate office, the overseas division, and the sales force. These sectors could each run the same application at the same time. If needed, the network accommodates separate human-machine interface applications suited to individual needs running simultaneously. The applications could even run during program modification. The implications of this are vast. Each sector of a company has an information system for their needs. The sales force has a tremendous sales tool.

Data issues

Another important aspect of human-machine interface systems is that of machine configuration. This allows setting up machine parameters and loading recipes. It permits modifying control parameters to accommodate conditions in the plant or the needs of management. Once again, distributed control and accessibility have vast value beyond the obvious. Individual departments upload parameters and data sets from the machines and processes for which they are responsible. Applications allow user access only to the parameters they require. Remote sites or sales demonstrations are allowed only to monitor the process.

An integration application logs data from the controller to a database. Many different databases are available and application interfaces exist for most of them. The integration application logs predetermined data to a database either periodically or based on

a Visual BASIC program using a DDE server, to a C++ program using a direct database sampling utility. The integration application links the database to a Web server. Most databases have associated Web server interfaces. When linking the database through a conventional Web interface, this application formats and displays information from the database on a Web page. The user's Web browser displays the information. The information updates whenever the page is loaded or re-loaded. Likewise, the Web page uses CGI scripts that allow the user to update information in the database. The driver or integration application then updates PLC fields accordingly.

Also, a JAVA or ActiveX application may use an HTTP stream to update fields on a web page. If the HTTP application links directly to the integration application and bypassing the database, then the browser displays live and changing data. Again, the user changes the PLC settings by making modifications within the browser's applet. Web-based database interfaces are convenient and powerful tools for true human-machine interfaces controlled over the Internet.

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events. Once the data exists in the database, standard tools, software, and applications manipulate the data. Again, it is not necessary that this database be on the local network. Data collected at a given plant gets logged to a database located on a computer in the corporate headquarters.

Then there is the issue of connectivity and database interfaces. The PLC network, whether serial or network based, connects to a server computer. A driver in the server communicates with the PLC and gathers data. This driver communicates with a database via an integration application. The primary objective of this application is to add features beyond the normal capabilities of a conventional interface. This custom application varies in sophistication based on the parameters of the project.

Examples of this application range from

Conclusion

The Internet and corporate intranets are increasingly viable and secure ways to program and troubleshoot PLCs remotely. Taking advantage of this technology offers numerous advantages, not the least of which is substantial time and money savings. Truly open PLCs connected to Ethernet TCP/IP is the best way to fully exploit the capabilities of PLCs and the Internet.

Acknowledgments

Some information in this paper was researched from an Internet article entitled *Introduction to the Internet Protocols* which is the property Charles L. Hedrick and Rutgers University. ©

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